4 Environmental Analysis

4.0 ENVIRONMENTAL ANALYSIS

4.1 INTRODUCTION TO ENVIRONMENTAL ANALYSIS

Section 4.0 describes existing (baseline) environmental conditions within the Project area by resource and evaluates impacts to these resources that could result from activities associated with the Project and its alternatives. Issues raised during public scoping (see Table 1.5-1) in Chapter 1, "Introduction," related to specific resources are addressed here, as are proposed mitigation measures for identified impacts.

The existing conditions and impacts are described only for resources within the geographic areas potentially affected by the proposed Project. In this draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR), impacts are considered for the construction and operation phases of the Project. The floating storage and regasification unit (FSRU) would be constructed abroad at an as yet undetermined shipyard; therefore, the effects of its construction are not considered in this EIS/EIR, but the Applicant would be expected to comply with environmental requirements of the host country.

This section is organized into resource subsections, each of which includes subsections corresponding to the following format:

- Environmental setting;
- Applicable regulatory framework;
- Significance criteria;
- Analysis of direct and indirect impacts;
- Mitigation measures for each impact; and
- Evaluation of the impacts of alternatives relative to those of the proposed Project.

The analysis of potential cumulative effects in conjunction with other existing or planned projects is described in Section 4.20, "Cumulative Impacts Analysis."

4.1.1 Baseline Conditions

Baseline conditions in the Project area were identified based on literature reviews and fieldwork. These conditions (such as existing air quality, population growth trends, and recreational opportunities) allow for characterization and anticipation of Project impacts and form a basis for any future evaluation of the Project.

Sources for the literature reviews included published technical reports, Internet resources, data from government sources, aerial photographs, and information provided by the Applicant. Where existing information regarding the Project area was insufficient or outdated, surveys and studies were conducted to determine the existing environmental setting. This work included geotechnical, marine archaeology, land use, and wetland surveys.

4.1.2 Regulatory Framework

Existing laws and regulations determine the nature, extent, and legal requirements of Project activities and may affect such Project factors as location, duration, footprint, discharges, work practices, mitigation, and agency cooperation. They may also specify permits and benchmarks necessary for Project authorization or evaluation. Laws, regulations, and permits may come from local, State, or Federal bodies and agencies.

4.1.3 Significance Criteria

Determination of an impact's significance is derived from standards set by regulatory agencies on the local, State, and Federal levels; knowledge of the effects of similar past projects; professional judgment; and plans and policies adopted by governmental agencies. The California Environmental Quality Act (CEQA) mandates that certain impacts be found to be significant. Significance criteria are identified in each applicable resource/issue area subsection. The CEQA Guidelines §15064.7 defines a threshold of significance (significance criteria) as "an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant."

4.1.4 Direct and Indirect Impact Analysis

In accordance with the CEQA and the National Environmental Policy Act (NEPA) and their implementing regulations, this EIS/EIR considers the direct and indirect effects of the proposed Project and its alternatives. Impacts are quantified as much as possible:

- *Direct impacts* are those that result from the action and occur at the same time and place. Dispersion of air pollutants from a vessel stack into the atmosphere is an example of a direct effect; and
- *Indirect impacts,* which are those reasonably foreseeable effects that are caused by the action but that may occur later and not necessarily at the location of the direct effect. For example, removal of vegetation in a waterway may increase the potential for sedimentation at that site or downstream later in the year.

Impact thresholds provide an overall measurement of how the proposed Project and its alternatives could influence the existing environment. The regulations issued by the Council on Environmental Quality (CEQ) to implement NEPA define significance of effects in terms of context and intensity. *Context* refers to the geographic area of impact, which varies with the physical setting of the activity and with each element of the environment analyzed. *Intensity* refers to the severity of the impact. Duration is also considered in the assessment of impacts:

- Temporary — returns to baseline after the activity stops;
- Short-term — returns to baseline on its own within one year of the activity;

- Long-term — returns to baseline after restoration and monitoring; and
- Permanent — never returns to baseline.

For this EIS/EIR, impacts are defined using four categories described in the following table (Table 4.1-1). Both California State Lands Commission (CSLC) and U.S. Geological Survey (USGS) criteria apply to the class definitions.

Table 4.1-1 Categories of Impacts

Class Definition	CSLC Criteria	USCG Criteria
Class I	Significant adverse impact that remains significant after mitigation	Major, permanent, long-term, or short-term
Class II	Significant adverse impact that can be eliminated or reduced below an issue's significance criteria	Minor, long-term
Class III	Adverse impact that does not meet or exceed an issue's significance criteria	Minor, short-term, or temporary
Class IV	Beneficial impact	Positive, may be major or minor, short- or long-term or permanent

Unless otherwise noted, all identified Class I and Class II impacts are considered to be potentially significant and adverse before application of the proposed mitigation. All Class III impacts are considered to be adverse, but do not exceed the significance criteria. Class I impacts cannot be mitigated to a level below significant. In some instances, the Applicant has proposed mitigation measures that, when implemented, would reduce a Class II impact to a Class III impact, or that would further reduce the potential severity of a Class III impact; these measures are identified by the prefix "**AMM**." All other mitigation measures have been recommended to the CSLC by staff, with the concurrence of the USCG and the Maritime Administration (MARAD), to further mitigate the environmental impacts; these measures are identified by the prefix "**MM**." Mitigation measures are discussed further in Section 4.1.6 below.

For each Class I impact, the CSLC and other State permitting agencies will have to make a Statement of Overriding Considerations per the CEQA Guidelines § 15093 to approve the Project.

4.1.5 Evaluation of Future Decommissioning

The impacts of decommissioning will be addressed in a separate EIS/EIR closer to the time of decommissioning because it would be speculative to project all future potential impacts of decommissioning at this time. Where removal of Project facilities is planned, many decommissioning impacts are expected to mirror those of construction. The Project lifespan is currently 40 years, but the license for a deepwater port (DWP) has no expiration date. Technologies and environmental conditions may change by the time the Project reaches the end of its useful life. Therefore, impacts related to decommissioning will not be discussed in the impact analysis. (See Section 2.6, "Future Plans, Decommissioning, and Abandoment" for additional discussion of decommissioning.)

4.1.6 Mitigation Measures

Mitigation measures are specific methods to prevent, minimize, or compensate for an activity's adverse effects. For each potential impact to a resource, a mitigation measure is identified by the Applicant (designated AMM as discussed in Section 4.1.4) or the EIS/EIR Project Team (designated as MM) to address the impact, and any adverse effects of the activity that remain after mitigation are discussed as residual impacts. If impacts remain significant after mitigation (i.e., continue to exceed the significance criteria), further measures may be proposed, or the impact may be determined to be significant and not mitigable (Class I).

Examples of types of mitigation measures are listed below. The first priorities are avoidance and prevention of impacts, but the priority of the remaining categories is less rigid:

- *Avoidance* — avoiding activities that could result in adverse impacts, and avoiding certain types of resources or areas considered environmentally sensitive (e.g., coral reefs);
- *Prevention* — measures used to impede the occurrence of negative environmental impacts;
- *Reduce or Eliminate/Minimization* — limiting or reducing the degree, extent, magnitude, or duration of adverse impacts;
- *Restoration* — rehabilitate or repair the affected environment; and
- *Compensation* — creation, enhancement, or protection of the same type of resource at another location to compensate for resources lost to development.

A Mitigation Monitoring Program (MMP) has been prepared by the CSLC staff and is in Section 6, "Conclusions and Recommendations" of this EIS/EIR. To assist in monitoring compliance during Project construction and operations, the MMP includes the measures identified by the Applicant and those identified by the EIS/EIR Project Team. The CSLC staff will recommend to its Commission that the MMP become part of any approvals of the Project. The Governor of California may also identify for MARAD, conditions of the Federal Deepwater Port (DWP) license that would make the proposed Project consistent with coastal zone management, land use plans and policies, and environmental considerations.

4.1.7 Evaluation of Alternatives

Impacts from alternatives are compared with those of the proposed Project in order to determine its relative environmental merit as well as the environmental feasibility of the alternatives. The feasible alternatives identified in Section 3 are considered and include no action, a Santa Barbara Channel/Mandalay Shore Crossing/Gonzales Road Pipeline

Alternative, a single-point mooring direct regasification concept, other onshore pipeline routes, and other shore crossings and pipeline connection routes.

4.1.8 Underlying Assumptions

The conclusions in this EIS/EIR are based on the analysis of the environmental impact and the following assumptions:

- The Applicant would comply with all applicable laws and regulations;
- The proposed facilities would be contracted, constructed, and operated as described in Section 2, "Project Description"; and
- The Applicant would implement the mitigation measures included in its application, the MMP (see Section 6), and in supplemental submittals to the USGC and the CSLC.

4.1.9 Environmental Setting: Offshore Oceanography and Meteorology

This subsection provides a description of the climatic and oceanographic setting at or near the proposed sites of the FSRU and offshore pipelines in order to provide an understanding of the factors that would have to be considered in the engineering design. It describes the weather conditions; air stability; mixing heights; and tidal, current, wind, and wave conditions. Marine water quality parameters, such as salinity, are discussed in Section 4.18, "Water Quality and Sediments." Tsunamis and beach erosion are discussed in Section 4.11, "Geologic Resources." The onshore environmental setting for the onshore portion of the Project is described in these resource area sections.

During scoping, concerns were raised whether the Project facilities could be safely designed to the given meteorology and oceanography conditions in the Project area. To date, designs are not finalized, nor are they required to be until after the license would be issued. However, the Applicant intends to design the FSRU and its mooring system based on 100-year wind/wave sea states with a 2-knot[1] (2.3 mph, 1.03-meters-per-second [m/s]) surface current originating from the most conservative direction. The final design will be reviewed in the manner discussed in Section 2.3, "Description of the Proposed Facilities."

Three nearby wave buoys are NOAA 46025 (Catalina Ridge) and Coastal Data Information Program (CDIP) Buoys 028 (Santa Monica Bay) and 102 (Point Dume). NOAA 46025 is approximately 7 nautical miles[2] (NM) (8.05 statute miles, 13 kilometers ([km]) south of the FSRU site and is the most exposed of the buoys. It also has the longest record (1982 to 2004). CDIP Buoy 102 (2001 to 2004) is closest to the FSRU site, approximately 4.9 NM (4.6 statute miles, 9 km) to the northeast across the shipping

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[1] 1 knot = 1.15 mile/hour (mph)

[2] 1 nautical mile = 1.15 statute miles = 2025 yards

lanes, and CDIP Buoy 028 (2000 to 2004) is approximately 16 NM (18.4 statute miles, 30 km) to the east (see Figure 4.1-1).

Cabrillo Port would be located within the Southern California Bight. The Southern California Bight extends south from Point Arguello to the Mexican border. Within the Southern California Bight are submarine canyons, peaks, and offshore islands. The offshore components of the Project would be located in the Santa Monica Basin. The Santa Monica Basin, in conjunction with the San Pedro Basin (referred to as the *Santa Monica-San Pedro Basin Complex*), is approximately 53.9 NM (62 statute miles, 100 km) long, 21.7 NM (25 miles, 40 km) wide, and 2,953 feet (900 meters [m]) deep at its maximum depth (see Figure 4.1-1) (Minerals Management Service Pacific Outer Continental Shelf Region 2001). The topography is heterogeneous over the basin complex, with the channel within the basins becoming narrower as depth increases. This blocks regional flow to an increasing degree with depth and completely blocks it below the deepest sill (Hickey 1992).

4.1.9.1 Circulation and Currents

Circulation in the Southern California Bight is complex (Minerals Management Service Pacific Outer Continental Shelf Region 2001). Regionally in the Southern California Bight, the California Current flows toward the equator and the Southern California Countercurrent flows towards the pole (see Figure 4.1-1). These two currents dominate circulation in the Southern California Bight. Where these two currents meet near the coast and near headlands (Point Conception and Point Arguello), upwelling occurs (National Oceanic and Atmospheric Administration 2002). Upwelling occurs when winds move the surface ocean water away from the shore. Offshore deeper water replaces the surface water. Because the ocean water is colder at greater depths, this replacement process causes the surface water to become colder (Academic Resources for Computing and Higher Education Services 2004). Local factors, such as forcing by winds and river flow, also influence currents, but these are weak and episodic.

The proposed Cabrillo Port site is at the inshore side of the Southern California Bight, where the mean circulation is counterclockwise. A northward countercurrent, the Davidson Current, exists near the proposed site. This countercurrent is strongest in summer and early fall and weak or even nonexistent in spring (Hickey et al. 2003). The southward California Current flows 53.9 NM to 80.8 NM (62 to 93 statute miles; 100 to 150 km) offshore and therefore does not influence the Project site (Hickey 1993).

Currents near the proposed site are typically northward in summer, fall, and winter. Table 4.1-2 summarizes the characteristics of these currents. In spring, there is an onshore flow. These velocity estimates are typically slower than currents measured at the eastern entrance to the Santa Barbara Channel, approximately 16 NM (18.4 statute miles, 29.6 km) to the northeast. Flows at Buoy 46025, which is more northward of the proposed Project, has higher recorded current speeds below the water surface during the spring (see Figure 4.1-1) (Hickey et al. 2003).

References: 1) (for ocean & wind currents) After B.M. Hickey, *Progress in Oceanography*, v30: 37-115, 1992;
2) for buoy data – (website) National Data Buoy Center, NOAA – www.ndbc.noaa.gov/station_page.php?station=46025; 3) for buoy data – (website) www.stormsurf.com/cgi-bin/shiro.cgi?a=28 and also .cgi?a=102

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CABRILLO PORT LNG DEEPWATER PORT EIS/EIR, 2004

Figure 4.1-1

Circulation in the Southern California Bight and Buoy Locations

Table 4.1-2 Characteristics of Currents near the Proposed Project		
Season	**Direction**	**Surface Speed**
Summer	Northward	1.4 knots (1.6 mph, 70 centimeters/second [cm/s])[a]
Fall	Northward	1.9 knots (2.2 mph, 1 m/s)[a]
Winter	Northward	1.0 knot (1.15 mph, 50 cm/s)[a]
Spring	Onshore	0.6 knot (0.7 mph, 30 cm/s)

[a] Bray et al. 1999

Oceanographic conditions in the vicinity of the proposed Project shift from upwelling, poleward push, and equatorward push on a 20- to 25-day cycle.

When winds and the currents are southward, upwelling can occur near Point Conception and near Point Dume. During upwelling, colder water is found near the coast and across the Santa Barbara Channel. When this occurs, water at the proposed site would flow southward from the Santa Barbara Channel. In the absence of upwelling, currents flow northward at the proposed site. This represents a poleward push. During poleward push, warmer water from the south travels northward. If this current weakens or reverses, an equatorward push can occur. In a push toward the equator, colder water flows from the north. An equatorward flow occurs past the Project site. During upwelling, poleward push, and equatorward push, currents fluctuate approximately 0.2 knot (0.23 mph, 0.1 m/s).

In the area of the proposed FSRU, tidal currents vary from 75 to 163 feet per minute (0.74 to 1.61 knots, 0.38 to 0.83 m/s) and generally flow from the northwest to the southeast. In general, the northwest/southeast tidal current ranges in velocities from 45 to 88 feet per minute (0.44 to 0.87 knots, 0.23 to 0.45 m/s), with the highest velocities 250 feet (76 m) beneath the surface (Münchow 1998).[3] Recent unpublished observations (Dever 2004) show that tides found near the ocean floor can be much stronger than those described above. From November 2002 to July 2003, velocities as high as 84 feet per minute (0.83 knots, 70 cm/s) were observed within 49 feet (15 m) of the bottom (656 feet [200 m] total water depth) at the eastern entrance to the Santa Barbara Channel. Although the design surface current is 2 knots (2.3 mph, 1.03 m/s), the current at depth would be considered in the riser/mooring analysis and design.

4.1.9.2 General Wave Climate

The Cabrillo Port area would be sheltered from waves from the northwest by Point Conception and the Channel Islands. In addition, the area would be partially sheltered from some south swell directions by the Santa Catalina, San Clemente, and Santa

[3] These current speeds were derived from conventional harmonic analysis and therefore do not include the total contribution of internal tides. Internal tides are generated by the interaction of the surface tides with bathymetry.

Barbara Islands. As a result, the average wave height in the proposed Cabrillo Port area is considerably lower than that outside the Channel Islands, but the directional wave spectra (distribution of wave energy with wave direction) at the site is much more complex than that in the open ocean.

The proposed Cabrillo Port and offshore pipeline area would be dominated by waves with periods greater than 10 seconds generated by distant storms (swell). From spring through fall, the dominant swell is generated by Southern Hemisphere storms, arriving from the south. Southern swells typically have peak wave heights of 1.6 to 4.9 feet (0.5 to 1.5 m) and peak wave periods of 14 to 20 seconds. During these same months, swells from tropical storms off Mexico, with wave periods of 8 to 17 seconds and 3.3- to 10-foot (1 to 3 m) wave heights, arrive from the south a few times each year.

During winter, the dominant swell is generated by North Pacific storms and arrives at the proposed FSRU area from the west. West swells typically have wave heights of 3.3 to 10 feet (1 to 3 m) and a peak period of 10 to 18 seconds. It is common to have south and west swells present in the proposed Cabrillo Port area at the same time, particularly during spring and fall.

In addition to swell, the proposed Cabrillo Port site is exposed to locally generated wind seas throughout the year, with wave periods less than 8 seconds and typical wave heights of 3.3 to 6.6 feet (1 to 2 m). Strong northwest winds offshore of the Cabrillo Port site, particularly during spring and summer, result in seas arriving from the west. Energetic sea events can develop in the Cabrillo Port area from the south, preceding the passage of low-pressure weather systems, and from the north to east during Santa Ana wind events.

The overall severity of winter wave conditions in the Cabrillo Port area can vary dramatically from year to year, depending on climatic weather patterns over the North Pacific. The worst winters are associated with strong El Niño periods on the U.S. West Coast, when west-to-east storm paths across the North Pacific are more likely to take a southerly course toward Southern California. Storms that pass near or through Southern California can generate large (greater than 6.6 feet [2 m] and up to 14.8 feet [4.5 m] in extreme cases) prefrontal wind seas from the south, followed by large (greater than 13 feet [4 m]) swells from the west at the port site. The worst El Niño storm wave scenario on record (1982 to 1983) was characterized by several time periods with multiple storms arriving in succession, resulting in unusually high sea and swell conditions in the proposed FSRU area for many days at a time.

The largest storm on record for the Port site area occurred on January 17 and 18, 1988. NOAA Buoy 46025 measured a maximum significant wave height (average height of the one-third highest waves) of 26 feet (8 m), with a peak wave period of 18 seconds. The proposed Cabrillo Port site benefits from additional island sheltering, compared with the buoy site. The applicant's wave hindcast for this event at the FSRU site produced a significant wave height of 24.6 feet (7.5 m), with a peak wave period 16.8 sec and a peak wave arrival direction from the southwest.

4.1.9.3 Extreme Wave Analysis

The Applicant performed an external wave hindcast and analysis for the proposed Cabrillo Port area. The characteristics of the Applicant's estimated 100-year wave events at the proposed Cabrillo Port site and shoreward end of the pipeline are provided in the table below (see Table 4.1-3). A 100-year wave event represents an event that has the probability of occurring once every 100 years. However, that does not mean that it will occur every 100 years; it could occur in two successive years. The term 100-year event simply states a probability of the occurrence of an event.

Table 4.1-3 Applicant-Calculated Significant Wave Heights

Location	Significant Wave Height (feet/meters)	Peak Period (seconds)	Peak Direction (degrees True)
Port	24.6 / 7.5	16.8	202.5 to 247.5
Pipelines	12.5 / 3.8	14	202.5 to 247.5

The peak direction is the true compass heading from which the waves arrive. The two offshore pipelines hindcast location is 34.13º N, 119.19º W, in a 39-foot (12 m) water depth, representing the shallowest location where the twin pipelines might enter the sea bottom after horizontal directional drilling (HDD) from shore.

4.1.9.4 Operational Wave Conditions

The operational wave conditions at the proposed Cabrillo Port site are characterized in part by the Applicant's hindcast estimate of the one-year return period of waves and by historical measurements by three buoys in the port area. The Applicant's estimated one-year return period wave height is 12.8 feet (3.9 m). A wave event of this size is most likely to have a peak period of 11 to 14 seconds and a peak arrival direction of 202.5 to 247.5 degrees True at the proposed Cabrillo Port site.

Table 4.1-4 summarizes the average number of days per year in which significant wave heights of 6.5, 8.2, and 9.8 feet (2, 2.5, and 3 m) were equaled or exceeded at the three buoy locations. In addition, the table shows the number of days exceeded in the years with the most frequent, average, and least exceedances of wave heights for each buoy.

Table 4.1-4 Numbers of Days in Which Waves Exceed Specified Heights at Buoys Located in the Vicinity of the Proposed Site of the FSRU

Buoy	Years	Number of Days in Which Waves Exceed 6.5 Feet (2 Meters)			Number of Days in Which Waves Exceed 8.2 Feet(2.5 Meters)			Number of Days in Which Waves Exceed 9.8 Feet(3 Meters)		
		Average	Most	Least	Average	Most	Least	Average	Most	Least
NOAA 46025	1982 to 2004	24	74	7	9	39	1	3	21	0
CDIP 028	2000 to 2004	10	12	8	3	5	2	1	1	1
CDIP 102	2001 to 2004	9	13	7	3	5	1	1	1	1

The years are defined from June 1 to May 31. Buoys 46025, 028, and 102 had sufficiently complete records to provide exceedance estimates for 16, four, and three years, respectively. The worst year on record (74 days with wave heights exceeding 6.6 feet [2 m]) was the El Niño winter of 1982 to 1983. In contrast, the best years on record had only approximately seven days with wave events exceeding 6.6 feet (2 m). The table shows that exceedance of the estimated one-year return period wave height of 12.8 feet (3.9 m) is likely to occur many times during a severe El Niño winter in Southern California and rarely occurred during non-El Niño winters. All the types of wave events described above can potentially produce waves exceeding 6.5 feet (2 m).

4.1.9.5 Meteorology and Climate

The climate of the Northern Channel Islands is characterized by mild winters and dry summers and is dominated by a strong and persistent high-pressure system known as the *Pacific High*. The Pacific High shifts northward or southward in response to seasonal changes or cyclonic storms. The Pacific High influences the presence of temperature inversions. The coast has early morning southeast winds (offshore), which shift to the northwest as the day progresses. In late spring and early summer, the northwest winds transport cool, humid marine air onshore, causing frequent fog and low clouds on the coast at night and in the morning (National Oceanic and Atmospheric Administration 2002).

Mean air temperatures from April 1982 to December 2001 at Buoy 46025, ranged from 13.9º Celsius (C) to 18.4º C (57º Fahrenheit [F] to 65.1º F), with a low of 5.5º C (41.9º F) and a high of 26.5º C (79.7º F) (National Buoy Data Center 2003) (see Table 4.1-5).

Winds

In general, sea breezes are northwesterly; however, there can be local variations. During summer these northwesterly winds are strong and continue into the night. In winter and occasionally in summer, southerly and easterly winds occur. During fall and winter the region is subject to Santa Ana winds, which are northeasterly winds that blow in from the inland desert regions. Santa Ana wind speeds typically range from 15 to 20 miles per hour (mph) (7.7 to 10.3 m/s), although they can reach 60 mph (30.9 m/s) (National Oceanic and Atmospheric Administration 2002).

From April 1982 to December 2001 at Buoy 46025 the maximum average wind speed was 43.1 mph (19.3 m/s), and the maximum peak wind gust was 55 mph (24.6 m/s) (see Table 4.1-5). The maximum hourly peak gust was 55.1 mph (24.6 m/s) (National Buoy Data Center 2003).

Table 4.1-5 Summary of Meteorological Ocean Conditions at Buoy 46025

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Air Temperature (4/82 to 12/01) (°C)													
Mean	14.2	13.9	14.0	14.4	15.3	16.3	17.7	18.4	18.4	17.8	16.2	14.5	15.9
Maximum	22.4	24.0	24.7	26.4	22.2	23.7	24.2	23.7	24.9	26.5	23.9	22.5	26.5
Minimum	8.4	7.3	8.9	9.1	10.9	11.5	13.4	13.1	14.1	12.8	10.8	5.5	5.5
Sea Temperature (4/82 to 12/01) (°C)													
Mean	14.7	14.6	14.7	15.2	16.5	17.9	19.4	20.1	19.9	19.0	17.1	15.3	17.0
Maximum	17.9	18.4	19.7	21.2	21.7	22.2	24.9	24.8	23.5	22.8	21.0	18.7	24.9
Minimum	11.8	11.8	12.2	11.5	12.8	13.3	16.0	16.4	16.0	15.2	12.8	12.4	11.5
Air-Sea Temperature (4/82 to 12/01) (°C)													
Mean	-0.5	-0.7	-0.8	-0.7	-1.3	-1.6	-1.6	-1.7	-1.4	-1.1	-0.9	-0.8	-1.1
Maximum	7.2	8.3	7.7	8.6	3.9	3.8	3.8	2.0	6.4	6.2	6.3	8.5	8.6
Minimum	-6.0	-6.6	-6.3	-5.7	-4.5	-7.9	-5.2	-7.4	-5.5	-5.1	-6.5	-9.0	-9.0
Dew Point Temperature (5/9 to 10/00) (°C)													
Mean	12.0	11.0	9.9	12.1	13.3	13.5	15.0	15.7	15.1	14.6	12.9	9.3	13.4
Maximum	15.9	14.9	14.4	17.9	18.9	18.9	18.9	21.0	20.5	19.1	18.5	15.0	21.0
Minimum	-0.8	2.9	-1.1	3.3	4.8	4.0	11.9	11.6	10.3	6.5	-0.7	-7.9	-7.9
Air-Dew Point Temperature (5/9 to 10/00) (°C)													
Mean	1.7	2.1	3.2	2.2	2.1	2.3	2.3	1.8	2.3	2.3	2.6	5.3	2.4
Maximum	16.7	10.3	17.3	15.8	10.4	9.6	6.0	5.6	8.2	15.6	16.4	27.1	27.1
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sea Level Pressure (4/82 to 12/01) (millibars)													
Mean	1,018.3	1,017.3	1,016.1	1,015.0	1,013.9	1,013.0	1,013.4	1,013.0	1,012.1	1,014.3	1,016.7	1,018.1	1,015.1
Maximum	1,031.5	1,028.9	1,025.6	1,027.2	1,023.3	1,022.2	1,021.2	1,020.4	1,020.7	1,023.4	1,028.9	1,032.1	1,032.1
Minimum	988.9	991.6	992.7	1,003.6	1,005.8	1,001.5	1,005.6	1,002.9	1,001.3	1,001.0	1,000.5	998.9	988.9

Table 4.1-5 Summary of Meteorological Ocean Conditions at Buoy 46025

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average Wind Speed (4/82 to 12/01) (knots)													
Mean	7.5	8.7	7.7	7.9	6.8	6.0	5.6	5.6	5.9	6.1	7.1	7.8	6.9
Maximum	33.0	36.0	32.7	36.5	37.5	25.1	19.6	19.8	22.4	32.9	30.5	36.9	37.5
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peak Wind Gust (4/82 to 12/01) (knots)													
Mean	9.5	11.0	9.9	9.9	8.8	7.8	7.4	7.3	7.7	8.0	9.1	10.0	8.9
Maximum	46.1	44.3	43.0	45.3	47.8	30.1	23.7	27.2	29.7	41.4	42.2	47.0	47.8
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hourly Peak Wind Gust (11/97 to 12/01) (knots)													
Mean	12.1	14.8	12.3	13.1	10.3	9.2	8.7	8.6	8.8	9.3	11.3	12.4	10.9
Maximum	37.3	47.0	40.4	45.1	36.0	27.4	19.8	22.9	20.6	29.0	37.1	40.0	47.0
Minimum	0.8	0.8	1.4	1.6	0.8	1.2	1.4	1.7	1.2	1.6	1.0	1.0	0.8
Significant Wave Heights (4/82 to 12/01) (meters)													
Mean	1.4	1.5	1.4	1.3	1.2	1.1	1.0	1.0	1.0	1.0	1.2	1.3	1.2
Maximum	8.0	6.3	6.8	3.9	4.3	2.8	2.2	2.6	3.2	3.5	4.3	7.2	8.0
Minimum	0.3	0.2	0.3	0.0	0.4	0.3	0.3	0.4	0.1	0.3	0.2	0.1	0.0
Average Wave Period (4/82 to 12/01) (seconds)													
Mean	7.1	7.1	6.8	6.2	6.1	6.0	6.0	5.8	6.0	6.2	6.3	6.7	6.4
Maximum	15.2	14.5	12.5	13.4	12.8	11.3	11.4	14.3	12.9	12.5	12.2	12.8	15.2
Minimum	3.0	2.9	3.5	0.0	3.2	3.1	3.8	3.0	3.3	2.9	2.7	2.6	0.0
Dominant Wave Period (4/82 to 12/01) (seconds)													
Mean	12.6	12.4	12.3	11.0	10.8	11.2	11.6	11.3	11.5	11.8	11.7	11.8	11.6
Maximum	25.0	25.0	25.0	25.0	25.0	20.0	20.0	25.0	25.0	25.0	25.0	25.0	25.0
Minimum	2.3	2.9	2.9	0.0	2.7	2.6	3.4	2.6	2.6	2.7	2.5	2.3	0.0

Visibility

Although there are no visibility data available for the specific Project area, Table 4.1-6 summarizes data from Point Mugu, which is located approximately 14 miles (22.5 km) from the FSRU. This dataset covers the years 1946 to 1993 and is the longest and most complete dataset for the vicinity of the Project. Although these data are for an onshore location, they are representative of the visibility conditions that could occur at the proposed FSRU location. The data in the table represent that percentage of time in which visibility is greater than the miles listed. In general, the greatest visibility (the least fog layer) occurs in winter and diminishes from spring through summer, with the least visibility occurring from August through October. Visibility is greater than 0.25-mile (0.4 km) 97.4 percent to 99.2 percent of the time. Visibilities less than 0.25-mile (0.4 km) are likely to slow marine traffic and interfere with navigation. Visibility greater than or equal to 10 miles (16 km) varies from close to 20 percent of the time in July, August, and September, to approximately 49 percent of the time in December, January, and February. Given that the FSRU would be more than 10 miles (16 km) offshore, it would more likely be visible in winter than in summer, but still less than about half of the time.

Table 4.1-6 Visibility Distances by Month at Point Mugu

Visibility Threshold (statute miles)	Month												
	Jan (%)	Feb (%)	Mar (%)	Apr (%)	May (%)	Jun (%)	Jul (%)	Aug (%)	Sep (%)	Oct (%)	Nov (%)	Dec (%)	Ann (%)
>=10	49.7	49.1	48.5	44.5	35.6	29.3	21.0	19.9	23.0	30.2	44.4	49.1	36.9
>=6	77.9	75.4	79.7	76.6	68.1	62.6	54.6	52.7	55.4	58.9	73.9	78.3	67.7
>=5	83.4	81.5	86.3	84.6	77.9	73.5	67.6	65.5	66.7	67.9	79.7	83.1	76.4
>=4	87.3	85.5	90.2	89.1	84.0	80.4	76.5	74.8	74.5	74.3	83.9	86.0	82.1
>=3	91.0	89.7	93.2	92.8	89.3	86.7	84.9	83.2	82.3	82.3	89.0	89.8	87.8
>=2.5	92.2	91.1	94.2	94.0	91.6	89.5	88.0	86.2	85.0	84.5	90.5	91.1	89.8
>=2	94.7	93.7	96.2	95.9	95.1	93.7	92.3	91.2	89.7	89.2	93.0	93.7	93.2
>=1.5	95.8	94.8	97.0	96.7	96.6	95.5	94.3	93.3	91.8	91.7	94.3	95.0	94.7
>=1.25	95.8	95.0	97.1	96.9	96.8	95.7	94.5	93.5	91.9	92.0	94.5	95.2	94.9
>=1	97.4	96.3	98.0	97.7	98.2	97.4	96.6	95.6	94.4	94.1	96.3	96.6	96.5
>=0.75	97.7	97.0	98.3	98.1	98.6	98.0	97.4	96.4	95.3	95.0	96.8	97.2	97.1
>=5/8	97.7	97.1	98.3	98.1	98.6	98.1	97.4	96.5	95.3	95.1	96.8	97.3	97.2
>0.5	98.3	97.6	98.7	98.5	99.1	98.8	98.3	97.6	96.6	96.3	97.4	97.8	97.9
>=5/16	98.4	97.8	98.9	98.6	99.3	99.0	98.6	97.9	96.9	96.4	97.6	98.0	98.1
>=0.25	98.8	98.4	99.2	99.1	99.6	99.5	99.2	98.8	98.0	97.4	98.1	98.4	98.7
>=0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

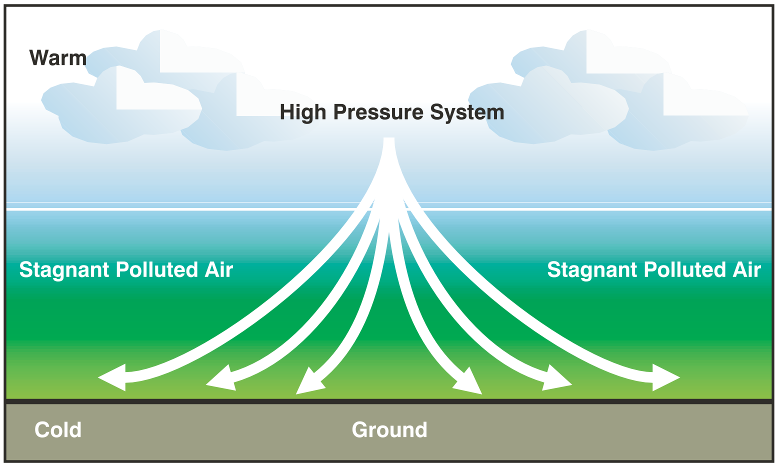
Source: International Station Meteorological Climate Summary 1995. Visibility statistics were derived from the archived dataset contained in the data from Point Mugu (34º07' N, 119º07' W).

Air Stability and Mixing Height

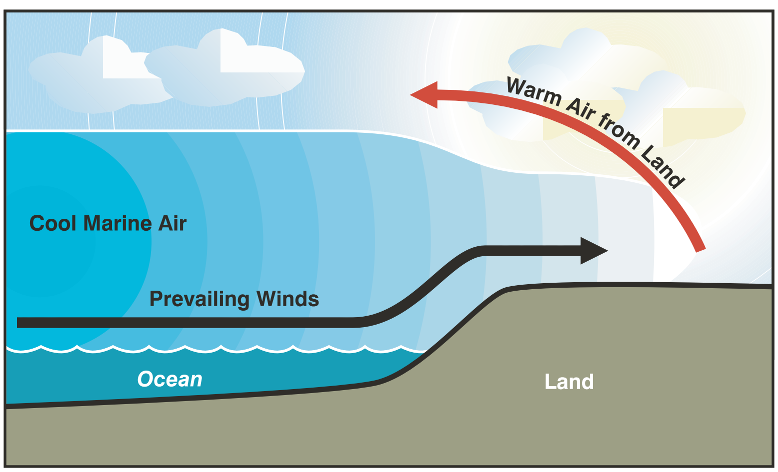
Stability is an atmospheric characteristic that affects air mixing. If the atmosphere is less stable, turbulence increases and the upper and lower atmosphere mix. Mixing height is measured at the distance from the ground to the atmospheric layer, where convection and turbulence promote mixing. If there is a combination of a high mixing height, unstable conditions, and moderate to high wind speeds within the mixed layer, then ventilation and dispersion are good (Minerals Management Service Pacific Outer Continental Shelf Region 2001).

Atmospheric stability affects pollutant concentrations in the region by regulating the amount of air mixing, horizontally and vertically. Increased atmospheric stability restricts mixing and is generally associated with low wind speeds. During these conditions, temperature inversions typically cap the pollutants that are emitted below. In inversions, a layer of warmer air lies above cooler air near the ground surface, which can prevent the upward flow of air, as shown on Figure 4.1-2.

According to atmospheric soundings at Vandenberg Air Force Base in Santa Barbara County, surface inversions occur from 0 to 500 feet (0 to 152 m) during winter and subsidence inversions occur (1,000 to 2,000 feet [305 to 610 m]) during summer. Vertical dispersion of pollutants generally does not occur when there is an inversion close to the surface and there is a large temperature gradient from the base of the inversion to its top. During summer along the California coast, subsidence inversions are common and are one of the principal causes of air stagnation and poor air quality (Minerals Management Service Pacific Outer Continental Shelf Region). During public scoping, concern regarding the effects that an inversion would have on the dispersion of a liquefied natural gas (LNG) release was raised. This issue is addressed in the Public Safety Section, Subsection 4.2.2.1, “Risk Assessment Process for the LNG Deepwater Port.”



Example of a High Pressure Inversion



Example of a Marine Inversion Layer

CABRILLO PORT LNG DEEPWATER PORT

Figure 4.1-2

Inversion Layers

SOURCE: From http:\\www.csun.edu (Entrix 2004).

4.1.11 References

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